AN INVESTIGATION OF THE NEED FOR ALTERNATIVE ENERGY RESOURCES: NUCLEAR POWER

The movement towards emissions-free energy production and carbon neutrality represents goals that currently go against society's ever-increasing demands for energy. The quest is for Western governments to find ways to facilitate the advance toward carbon neutrality and thereby help preserve our planet's well-being. The ominous and unsettling global warming crisis can only be solved by eliminating our reliance on fossil fuels. Accordingly, by assessing alternative energy options, this paper will argue that dependence on fossil fuels can be greatly reduced through the increased expansion of nuclear power. While there has not been a rapid development of new reactors in recent years, mainly due to lingering public resistance to change, there is reason to believe that this pattern will change (Cravens 2008). This prediction appears even more likely, given the effectiveness of current safety regulations and efficiency in which energy is produced. Ultimately, this paper will show that society can, in fact, curb the effects of climate change with present day technologies and strategies, and that progress will not be inhibited by a lack of scientific advancement, but rather by society's motivation to change.

Before the Industrial Revolution, the amount of carbon movement amid the soil, forests, oceans and atmosphere was reasonably fixed. But through the burning of fossil fuels, this balance has been tilted, yielding to global warming, which is growing at a perilous pace and has created “a planetary emergency” (Gore 2006). When fossil fuels are burned, carbon dioxide is released into the atmosphere. The molecular structure of carbon dioxide traps heat that would otherwise radiate back to space. It is comparable to an invisible atmospheric blanket or the panes of a greenhouse. The global supply of carbon dioxide had been stable for thousands of years but as we continue to burn fossil fuels, and persist in such activities as deforestation and intensive agriculture, larger and larger quantities of carbon dioxide are added to the atmosphere. Today, the atmosphere contains 32 percent more carbon dioxide than at the start of the Industrial Revolution (Suzuki 2009). Without reducing emissions, the average temperature of the planet will rise four to eight degrees in the course of the century (McKibben 2007).

Every year, approximately 26 billion tonnes of carbon dioxide are pumped into the atmosphere, preventing heat from escaping the earth’s surface (Clegg 2007). About a quarter is absorbed by the oceans and another quarter is absorbed by the vegetation on the land. The rest is added to the greenhouse layer resulting in climate change altering long term weather patterns (Clegg 2007).

The planet's average temperature has risen by 0.6 degrees Celsius since 1900 and the northern hemisphere is currently warmer than at any other time over the last thousand years (Suzuki 2009). Higher temperatures expected in coming years along with rising sea levels and anticipated increases in flooding and droughts will disproportionately affect agriculture in the planet's lower latitudes where most of the world's poor live (Weiss 2007).

Per capita, Canada produces twice as much carbon dioxide as Germany, and five times as much compared to China. Alberta, home of Canada's oil and gas industries contributes 31.4 percent of the total Canadian emissions while having only 10 percent of the population (Weaver 2008). The fossil fuel industry, represented by the crude oil, coal, and natural gas producers, together with the tar sands sector, including petroleum refineries, contribute up to 20 percent of all Canadian greenhouse gas emissions (Weaver 2008). The Canadian government has a great stake in Alberta's tar sands and preserving this source of revenue is a fundamental consideration driving the ambitions of the government. Nevertheless, there must be encouragement to investigate other sources of energy in a move towards carbon neutrality. The oil, coal and gas lobbies decry the search for alternative sources of energy saying this will be too costly and result in job losses. However, low emissions do not necessarily mean a drop in the gross domestic product.

For example, in the U.S., California has the second lowest per capital emissions rate, yet it produces the ninth highest gross domestic product per capita (Weaver 2008).

It is apparent that the multifaceted relationship between fossil fuels and the entire structure of contemporary society has seemingly yielded an atmosphere in which new energy alternatives are only deemed viable if they can maintain the status quo. While such alternatives are not able to replace the use of fossil fuels at the present time, they can certainly be incorporated into society's current energy plans. The bleak reality is that new technologies aimed at harnessing renewable energy will only gain rapid societal acceptance if and when they have proven to be economically sound. While alternative energy sources must be embraced, they must first be assessed as to whether or not they are safe in both the short and long term, and whether they are cost-effective.

Furthermore, nuclear energy offers a viable and potential solution towards zero emissions. This energy source is very efficient and predictable, producing electricity on a large scale and emitting almost no carbon dioxide, for the simple reason that it does not burn anything.

In 2008, more than 435 nuclear reactors existed in 32 countries, and they held a safety record far superior to that of fossil fuel or hydroelectric generation (even when taking into consideration the Chernobyl catastrophe) (Cravens 2008). Presently, nearly six percent of the world's total energy usage and more than 18 percent of the world's electricity production is generated from nuclear fission reactors (Van Der Zwaan 2002). France, for instance, has reduced its carbon dioxide emission by over 20 percent over the last ten years by aggressively setting up nuclear reactors (Dresselhaus and Thomas 2001).

The drive towards nuclear power in North America, however, was far less welcomed when compared to France. The economic hardships of the 1970s, coupled with declining costs of fossil fuels during the mid 1980s made the construction of nuclear plants rather unappealing (Cravens 2008). Unlike France, the U.S. government was far less willing to either advance a national energy program or interfere with its private investors. Furthermore, opposition to nuclear power gained much political momentum in the aftermath of the near-meltdown at Three Mile Island in 1979, and later with the catastrophe at Ukraine's Chernobyl reactor in 1986 (McKibben 2007). Ultimately, Canadian and American policy alike was designed to ensure a cheap and readily available energy source for its citizens without any regard for a long-term investment in nuclear power.

It would indeed be a fallacy to assert that nuclear energy was not without its downside, namely a major problem concerning radioactive waste, but also issues of nuclear proliferation and reactor accidents. Despite the fact that nuclear energy has been proven to be a viable competitor to fossil fuels, it generally falls short of being a cost-effective energy choice. In all likelihood, however, the greatest obstruction to instituting this energy source is the strong resistance promulgated by unfavourable public opinion of nuclear energy, rather than any technical or fiscal impediments (McKibben 2007). However, from the time the issue of global warming took hold in the 1990s, the view has been advanced that fission could have a part to play in lowering carbon dioxide emissions. Consequently, there are those who assert that the use of nuclear energy should continue to remain a viable option and perhaps even garner more attention (Van Der Zwaan 2002).

The Intergovernmental Panel on Climate Change (IPCC) has estimated that only a two percent increase in the number of nuclear reactors would greatly contribute to stabilizing carbon emissions (McKibben 2007). However, this would result in an increase of more than three thousand tonnes of highly radioactive waste per year (Boyle 2004). Currently, the most pragmatic solution for purging such wastes appears to be storing them deep underground in geological depositories.

For instance, Atomic Energy of Canada Limited (AECL) has long proposed that the federal government develop plans to store large amounts of nuclear refuse deep beneath the granite rock of the Canadian Shield. Similarly, in the U.S., there has been an increasing amount of support for the expansion of nuclear waste facilities in Nevada's Yucca Mountain. Like the granite rock of the Canadian Shield, Yucca Mountain contains large deposits of tuff (volcanic rock), which is considered by some scientists to be a viable location for storing radioactive waste (Cuddihy, Kennedy and Byer 2005).

Although a significant amount of research has been directed towards establishing and confirming the reliability of long-term geological depositories, no country, to this date, has found a permanent solution for the disposal or storage of radioactive waste (Van Der Zwaan 2002). This can largely be explained by the fact that governments do not want to take too strong of a stance on such energy policies, given that the integrity of toxic waste containers in the long-term remains inconclusive. It has been argued that as spent fuel canisters break down over thousands of years, long-lasting radioactive materials, like plutonium-239 and uranium-235, could theoretically seep through rocks and enter into water supplies, yielding the potential for grave catastrophes such as mass deaths, birth defects, mutations, and/or cancers (Dresselhaus and Thomas 2001).

In order to help manage with the issue of radioactive waste disposal, it has been proposed that world leaders and nuclear agencies alike need to mandate designated international facilities for spent fuel. Given that it is remarkably ineffective and potentially unsafe for every country to have its own disposal facilities, the creation of “internationally monitored waste repositories” may prove to be a viable option for storage (Van Der Zwaan 2002).

Further research must be conducted towards understanding how to reduce the radioactive byproducts of nuclear energy, in addition to the study of the long-term dependability of depositories. As new reactors are constructed and put online, the need for additional depository facilities will become inevitable (Van Der Zwaan 2002). It is worth noting that innovative nuclear technologies are currently being developed to help alleviate concerns over waste disposal and storage, and key advancements have been made with the use of alternative nuclear fuels (i.e. alternatives to uranium). Specifically, the use of thorium, a natural and somewhat radioactive metal, has been effectively shown to be a safe alternative for fueling nuclear reactors and generating electricity. Not only is thorium three to four times more abundant than uranium, it exists as only a single isotope, thereby allowing all mined deposits to be utilized in reactors and bypassing the requirement for separating isotopes (Cravens 2008).

Further, nuclear power derived from thorium holds additional benefits over uranium in that it can significantly impede nuclear proliferation, since in addition to causing a decrease in waste, there is also a great reduction in the byproduct of plutonium. Ultimately, while thorium reactors are not free from complications, as they are more difficult and expensive to construct, they clearly offer a realistic approach to producing safe, carbon-free electricity, and thereby warrant increased attention in research and resources (Cravens 2008).

Taking a long-term view about the rise in global temperature and the increasing demand for electricity, society must decide if the risks of enriching uranium are greater than the risks of mining fossil fuels. While many environmentalists and politicians have argued in favour of nuclear power, it has been cautioned that such a move could mean exchanging one environmental catastrophe for another. Given that plutonium-239 takes 24,000 years to lose half of its radioactivity, there is ultimately no safe place to dump nuclear waste (Gordon and Suzuki 1990). Although nuclear power is widely considered to be a safe alternative, it does not command public confidence, due to the fact that it is not completely free from danger and has been tainted by mistakes that have occurred in the past.

Nevertheless, nuclear power and its regulators continue to be stringently monitored and supervised, providing support for the increased development of new reactors, along with the modern reality that the use of fossil fuels can be significantly reduced.

At the present time, nuclear energy can only be implemented in the form of electricity. Given that electricity provides about one-third of the world's total energy supplies, it is apparent that nuclear energy is capable of playing an important role in alleviating carbon emissions. However, the capabilities of this technology have an even farther-reaching potential in that nuclear power may one day enter into another major carbon emission domain, namely, the transportation sector. Theoretically, non-carbon emitting fuels, such as hydrogen, could be harnessed to fuel future transportation (Van Der Zwaan 2002). This illustrates another use of nuclear energy in an alternative form to electricity, providing further reason to invest in this technology. Although nuclear energy is not amenable to being utilized directly as fuel, it could potentially serve as a means to produce carbon-free fuel (e.g., for transport). It is noteworthy that photovoltaics or other renewable sources could also be harnessed to produce hydrogen, so that — if desired — the use of fission could be avoided. Presently, the scheme for a hydrogen economy seems promising for the future.

Its delay has not been due to a dearth of scientific knowledge, but rather, due to the high monetary investment and lack of public and governmental support (Van Der Zwaan 2002).

In conclusion, the development of technological solutions to global warming begins with emergent sources of alternative energy. A commitment must be made to reduce carbon emissions through conservation, in addition to the use of renewable energy resources. Nuclear fission reactors have been studied and tested for years and have undergone real world evaluation. Now, after decades of experimentation, they appear to be sufficiently safe and because of the very demanding federal regulations, newer reactors are less accident prone than ever before. Furthermore, while nuclear energy may represent a valuable and perhaps necessary component for mitigating carbon emissions, it is crucial to further understand the physical and social challenges that accompany the technology. It remains vital that this energy option continue to be the focus of ongoing research and developmental studies. Only at such time that the investigation and the expansion of these studies increase into all non-carbon energy technologies will people be able to properly scrutinize the choices available and concoct the right combination of energy options to tackle head-on the perils of global warming and climate change.

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